5

# Twelve Mile Creek Family Level Benthic Macroinvertebrate Bioassessment Spring 1992

**Prepared by:**
**Ross L. Self**
**and**
**Pat V. Vezertzis**
**Fisheries District II**
**South Carolina Wildlife and Marine Resources Department**
**Abbeville, South Carolina**

**Introduction:**

Polychlorinated biphenyl (PCB) contamination was discovered in fish flesh from Lake Hartwell in 1976 by the South Carolina Department of Health and Environmental Control (SCDHEC) and the Environmental Protection Agency (EPA). The source of the contamination was determined to be Sangamo Weston, Inc. Sangamo Weston, Inc. used PCBs in the manufacture of capacitors at their plant near Pickens, South Carolina. The plant was located adjacent to Town Creek, a tributary of Twelve Mile Creek which flows into Lake Hartwell. PCBs were used at the plant from 1955 through 1977.

Family level benthic macroinvertebrate bioassessments were conducted in the Twelve Mile Creek drainage to evaluate habitat impairment possibly resulting from PCB exposure. The assessments were conducted as a part of the biological investigations required for the Remedial Investigation/Feasibility Study at the Sangamo Weston, Inc./Twelve Mile Creek/Lake Hartwell PCB Contamination Superfund Site Operable Unit Two.

**Methods:**

Family level benthic macroinvertebrate bioassessments were conducted at nine sites in the Twelve Mile Creek drainage and at one reference site (Figure 1 and Table 1). Methods employed were those described for Rapid Bioassessment Protocol II for benthic macroinvertebrates (Plafkin *et al.* 1989). The only modification to the protocol was to preserve collected organisms for identification in the laboratory as opposed to field identification. The modification was made to allow accurate family level taxonomic assignment (Merritt and Cummins, 1984; Pennak, 1989; Thorp and Covich,1991) and facilitate field activities. Taxa tolerance values were assigned from the "Freshwater Macroinvertebrate Species List Including

Tolerance Values and Functional Feeding Group Designation for Use in Rapid Bioassessment Protocols" prepared for EPA by EA Mid-Atlantic Regional Operations, Engineering, Science, and Technology, Inc. (March 1990, Report No. 1107.05) and an unpublished taxa tolerance list used by the Rivers and Reservoirs Lab, Auburn University, Alabama (Dr. Cliff Webber, personal communication).

**Results and Discussion**

Forty-five benthic macroinvertebrate taxa were identified from ten sites (Table 2). Tolerance values (TV) and functional feeding group designation (FFG) for each taxa identified are listed in Table 2. Tolerance values range from 0 for organisms very intolerant of organic pollution to 10 for organisms very tolerant of organic pollution.

Metric values for the nine sample sites and the reference site are presented in Table 3. Taxa richness (Metric 1) ranged from 17 at the reference site and Site 14 (Rice Creek) to 8 at Site 12 (Lower Town Creek). Site 12 is immediately down stream of the Samgamo Weston, Inc. plant site. Site 11 (Upper Town Creek) is located upstream of the plant site and had a taxa richness of 16, twice that of the site immediately downstream of the plant.

Metrics based on the abundance of intolerant forms (Metric 4, EPT/Chironomidae and Metric 6, EPT index) had the greatest variablilty between sites. Site 11 had the highest value for Metric 6 indicating an abundance of intolerant forms. Site 5 (Twelve Mile Creek downstream of Town Creek) had the lowest values for Metric 4 and Metric 6 indicating a reduction in the presence of the more intolerant EPT taxa. Site 5 also had one of the highest values for the percent contribution of the dominate taxa (59.4 %). A community dominated by few families is indicative of environmental stress (Plafkin *et al* 1989).

Metric percent comparisons, bioassessment scores by metric and bioassessment results are presented in Tables 4, 5 and 6. Total scores (Table 6) ranged from 42 to 15. Site 11 was classified as non-impaired relative to the reference stream. The eight remaining sites were classified as moderately impaired. Scores for the moderately impaired sites range from 36 at Site 10 (Middle Fork) and Site 14 (Rice Creek) to 15 at Site 5.

The average score for sites upstream of the Sangamo Weston Inc. plant site ( Sites 2, 4, 10 and 11) was 35.25. Sites downstream of the plant (Sites 5 and 12) averaged a score of 24. Sites located in tributaries downstream of the plant (Sites 13, 14 and 15) had an average score of 30.

**Conclusions**

Eight of the nine sites sampled in the Twelve Mile Creek drainage were classified as moderately impaired. Site 11 located upstream of the Sangamo Weston, Inc. facility was classified as non-impaired and had high values for taxa richness and exhibited an abundance of the intolerant EPT taxa. Sites immediately downstream of the Sangamo facility exhibited evidence of greater impairment than did upstream sites or downstream tributary sites. The merging of these data with the results of sediment and fish contamination evaluations should allow inferences to be drawn as to the contribution of PCBs to the habitat impairment manifested in the macroinvertebrate communities.

**Literature Cited**

Merritt, R. W. and K. W. Cummins. 1984. An introduction to the aquatic insects of North America, 2nd Ed. Kendall/Hunt, Dubuque, Iowa. 722 pp.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Grass and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency EPA/444/4-89-001.

Pennak, R. W. 1989. Freshwater invertebrates of the United States. 3rd Ed.: Protozoa to Mollusca. John Wiley and Sons, N.Y. 628 pp.

Thorp, J. H. and A. P. Covich. 1991. Ecology and classification of North American freshwater invertebrates. Academic Press, Inc. N.Y. 911 pp.

Table 1. Benthic macroinvertebrate bioassessement sample sites. Spring 1992.

| Station | Creek | County | Location |
|---|---|---|---|
| Reference | Six and Twenty Mile Creek | Anderson | 11 miles north of Anderson, SC at secondary road 174 |
| Site 2 | North Fork Twelve Mile Creek | Pickens | off secondary road 34 near Squirrel Ridge |
| Site 4 | Twelve Mile Creek | Pickens | at secondary road 174, upstream of Town Creek |
| Site 5 | Twelve Mile Creek | Pickens | at SC 183, downstream of Town Creek |
| Site 10 | Middle Fork Twelve Mile Creek | Pickens | at secondary road 33 |
| Site 11 | Town Creek | Pickens | above Sangamo plant at undeveloped road between secondary road 207 and SC 8 |
| Site 12 | Town Creek | Pickens | below Sangamo plant at secondary road 23 |
| Site 13 | Wolf Creek | Pickens | at secondary road 138 |
| Site 14 | Rice Creek | Pickens | at secondary road 222 |
| Site 15 | Golden Creek | Pickens | at secondary road 158 |

Table 2 (cont). Benthic macroinvertebrate taxa collected in the Twelve Mile Creek Drainage and Six and Twenty Mile Creek referance site with their associated tolerance values (TV) and functional feeding group designations (FFG). Spring, 1992.

| TAXA | TV* | FFG** |
|---|---|---|
| Plecoptera | | |
| Nemouridae | 2 | SH |
| Peltoperlidae | 2 | SH |
| Perlidae | 1 | P |
| Perlodidae | 2 | P |
| Pteronarcyidae | 0 | SH |
| Trichoptera | | |
| Brachycentridae | 1 | FC |
| Hydropsychidae | 4 | FC |
| Hydroptilidae | 4 | PI |
| Lepidostomatidae | 1 | SH |
| Leptoceridae | 4 | CG |
| Limnephilidae | 4 | SH |
| Philopotamidae | 3 | FC |
| Rhyacophilidae | 0 | P |
| OTHER AQUATIC INVERTEBRATES | | |
| Decapoda | | |
| Astacidae | 6 | SH |
| Hirudinoidea | 8 | P |
| Hydracarina | 5 | na |
| Mollusca | | |
| Corbiculidae | 4 | FC |
| Oligochaeta | 10 | CG |
| Lumbriculidae | 8 | CG |
| Naididae | 8 | CG |
| Tubificidae | 10 | CG |

* TV ranges from 0 (intolerant) to 10 (tolerant).

** FFG code: SH = Shredder
CG = Collector/Gatherer
FC = Filtering Collector
SC = Scraper
P = Predator
PI = Piercer

Table 2 (cont). Benthic macroinvertebrate taxa collected in the Twelve Mile Creek Drainage and Six and Twenty Mile Creek referance site with their associated tolerance values (TV) and functional feeding group designations (FFG). Spring, 1992.

| TAXA | TV* | FFG** |
|---|---|---|
| Plecoptera | | |
| Nemouridae | 2 | SH |
| Peltoperlidae | 2 | SH |
| Perlidae | 1 | P |
| Perlodidae | 2 | P |
| Pteronarcyidae | 0 | SH |
| Trichoptera | | |
| Brachycentridae | 1 | FC |
| Hydropsychidae | 4 | FC |
| Hydroptilidae | 4 | PI |
| Lepidostomatidae | 1 | SH |
| Leptoceridae | 4 | CG |
| Limnephilidae | 4 | SH |
| Philopotamidae | 3 | FC |
| Rhyacophilidae | 0 | P |
| OTHER AQUATIC INVERTEBRATES | | |
| Decapoda | | |
| Astacidae | 6 | SH |
| Hirudinoidea | 8 | P |
| Hydracarina | 5 | na |
| Mollusca | | |
| Corbiculidae | 4 | FC |
| Oligochaeta | 10 | CG |
| Lumbriculidae | 8 | CG |
| Naididae | 8 | CG |
| Tubificidae | 10 | CG |

* TV ranges from 0 (intolerant) to 10 (tolerant).

** FFG code: SH = Shredder
CG = Collector/Gatherer
FC = Filtering Collector
SC = Scraper
P = Predator
PI = Piercer

Table 3. Benthic macroinvertebrate bioassessment metric values for sample sites in the Twelve Mile Creek drainage and reference site. Spring 1992.

| Site | Metric Value | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Metric 1 | Metric 2 | Metric 3 | Metric 4 | Metric 5 | Metric 6 | Metric 7 | Metric 8 |
| 6&20 Mile Creek (Ref) | 17 | 3.95 | 0.12 | 4.16 | 21.5 | 79 | 0.00 | 0.03 |
| North Fork (2) | 13 | 4.22 | 0.23 | 12.57 | 59.2 | 88 | 0.46 | 0.00 |
| Middle Fork (10) | 12 | 1.96 | 15.14 | 16.76 | 62.4 | 134 | 0.83 | 0.09 |
| Upper 12 Mile Creek (4) | 11 | 3.41 | 0.92 | 16.71 | 51.6 | 117 | 0.82 | 0.00 |
| Upper Town Creek (11) | 16 | 4.58 | 1.93 | 9.50 | 40.0 | 152 | 0.63 | 0.16 |
| Lower Town Creek (12) | 8 | 4.06 | 0.08 | 7.69 | 58.2 | 123 | 1.25 | 0.01 |
| 12 Mile Creek (5) | 12 | 6.15 | 0.00 | 0.38 | 59.4 | 26 | 0.75 | 0.02 |
| Wolf Creek (13) | 13 | 4.45 | 0.85 | 4.04 | 33.3 | 97 | 0.61 | 0.00 |
| Rice Creek (14) | 17 | 4.62 | 1.27 | 11.14 | 32.7 | 30 | 0.00 | 0.07 |
| Golden Creek (15) | 10 | 3.85 | 0.05 | 0.75 | 51.5 | 38 | 0.90 | 0.02 |

Table 4. Benthic macroinvertebrate bioassessment metric percent comparisons of sample sites in the Twelve Mile Creek drainage to the reference site. Spring 1992.

| Site | Metric Percent Comparison | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Metric 1 | Metric 2 | Metric 3 | Metric 4 | Metric 5 | Metric 6 | Metric 7 | Metric 8 |
| 6&20 Mile Creek (Ref) | - | - | - | - | 22 | - | - | - |
| North Fork (2) | 76 | 94 | 189 | 302 | 59 | 111 | - | 0 |
| Middle Fork (10) | 71 | 202 | 12,617 | 403 | 62 | 170 | - | 310 |
| Upper 12 Mile Creek (4) | 65 | 116 | 769 | 402 | 51 | 148 | - | 0 |
| Upper Town Creek (11) | 94 | 86 | 1,625 | 228 | 40 | 192 | - | 529 |
| Lower Town Creek (12) | 47 | 97 | 66 | 185 | 58 | 156 | - | 11 |
| 12 Mile Creek (5) | 71 | 64 | 0 | 9 | 59 | 33 | - | 79 |
| Wolf Creek (13) | 76 | 89 | 713 | 97 | 33 | 123 | - | 79 |
| Rice Creek (14) | 100 | 85 | 1058 | 268 | 33 | 38 | - | 233 |
| Golden Creek (15) | 59 | 103 | 46 | 18 | 52 | 48 | - | 77 |

Table 5. Benthic macroinvertebrate bioassessment scores by metric for sample sites in the Twelve Mile Creek drainage and the reference site. Spring,1992.

| Site | Bioassessment Score | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Metric 1 | Metric 2 | Metric 3 | Metric 4 | Metric 5 | Metric 6 | Metric 7 | Metric 8 |
| 6&20 Mile Creek (Ref) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| North Fork (2) | 3 | 6 | 6 | 6 | 0 | 6 | 6 | 0 |
| Middle Fork (10) | 3 | 6 | 6 | 6 | 0 | 6 | 3 | 6 |
| Upper 12 Mile Creek (4) | 3 | 6 | 6 | 6 | 0 | 6 | 3 | 0 |
| Upper Town Creek (11) | 6 | 6 | 6 | 6 | 3 | 6 | 3 | 6 |
| Lower Town Creek (12) | 3 | 6 | 6 | 6 | 0 | 6 | 3 | 3 |
| 12 Mile Creek (5) | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 6 |
| Wolf Creek (13) | 3 | 6 | 6 | 6 | 3 | 6 | 3 | 0 |
| Rice Creek (14) | 3 | 6 | 6 | 6 | 0 | 6 | 3 | 0 |
| Golden Creek (15) | 3 | 6 | 3 | 0 | 0 | 0 | 3 | 6 |

Table 6. Benthic macroinvertebrate bioassessment results for sample sites in the Twelve Mile Creek drainage and the reference site. Spring 1992.

| Site | Bioassessment Results | | |
|---|---|---|---|
| | Total Score | Percent Comparison | Biological Condition |
| 6&20 Mile Creek (Ref) | 48 | Reference | Reference |
| North Fork (2) | 33 | 69 | Moderately impaired |
| Middle Fork (10) | 36 | 75 | Moderately impaired |
| Upper 12 Mile Creek (4) | 30 | 63 | Moderately impaired |
| Upper Town Creek (11) | 42 | 88 | Non-impaired |
| Lower Town Creek (12) | 33 | 69 | Moderately impaired |
| 12 Mile Creek (5) | 15 | 31 | Moderately impaired |
| Wolf Creek (13) | 33 | 69 | Moderately impaired |
| Rice Creek (14) | 36 | 75 | Moderately impaired |
| Golden Creek (15) | 21 | 44 | Moderately impaired |